

Final Report on NASA Grant NCC 2-3

Development of 3500°F Ceramic/Carbon Tile for TOPHAT

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Research Objective: Development of ceramic coated carbon felt which will produce a rigid tile insulation for the TOPHAT system capable of surviving 3500°F without dimensional change or oxidation.

Approach: Previous studies on TOPHAT have shown that CVD/CVI coating of carbon fiber with SiC can provide a reusable CMC thermal protection system to 3000°F. This knowledge will be applied to low density carbon felt to develop a rigid tile insulation for the TOPHAT system which will have similar performance as the outer CMC.

Accomplishments: The first step was to locate a carbon tile which would have low density and provide for good infiltration properties. Several commercial and non-commercial carbon felts were investigated. These include two types of rigid carbon tile from Oak Ridge, National Carbon Corp. carbon felt, FMI Fiberform rigid carbon tile, and FMI Carbon Felt. Test specimens, 1" cubes, from each of the carbon materials were prepared and coated with CVI SiC. These were then oxidized at 2400F. The rigid carbon tiles from Oak Ridge and FMI showed very poor performance, having high mass loss and having extensive oxidation of the carbon fiber. National Carbon felt and FMI carbon felt showed much better performance, with FMI carbon felt having the least oxidation and the most uniform SiC infiltration. Several test specimens were then infiltrated with SiC to densities ranging between 11 lbs/cuft and 21 lbs/cuft. Felts with densities between 15 lbs/cuft and 21 lbs/cuft performed best with only some mass loss which ended after five cycles.

Significance: Current ceramic tile insulation for the TOPHAT system is unable to survive at temperatures above 2800°F. Ceramic coated carbon tile has already demonstrated reusability to 3000°F and has the potential for reuse to temperatures approaching 3500°F. Development of the TOPHAT system to temperatures of 3500°F will require an improved insulation in order to meet its design goals.

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